METHOD AND DEVICE FOR CLEANING OF TEXTILE MATERIALS IN A WATER ENVIRONMENT

FIELD OF THE INVENTION

This invention relates to a method and a device for cleaning the textile materials in water environment, more specially to cleaning, disinfecting and softening of textile materials which could be used in a domestic environment for cleaning of soiled textile materials, including clothes of natural and synthetic textile materials.

BACKGROUND OF THE INVENTION

Various methods and devices for cleaning of textile materials in a domestic environment are known, especially for clothes. Most often for removing the contaminations a mechanical stirring of water solution and soap powder is used with the processed materials in it. In other methods the cleaning effect is achieved by acoustic waves within the sound and ultrasound range. Acoustic waves are generated by transforming the electrical energy into mechanical energy by means of different electromagnetic, piezoelectric and magnetostrictive transformers.

Author's Certificate SUN 1 730 288 describes a method for washing underwear in a water environment, including steps of prewashing and main washing, rinsing by warm and cold water, where during the entire washing cycle hydro-acoustic vibrations are delivered into the washing environment at a frequency of a 1 to 3 kHz and a vibration intensity of 0,1 to 0,5W/cm. The washing and rinsing of the underwear is carried out in an impulse mode with a frequency of the impulses at about from 1 to 2 kHz.

The disadvantages of the known method are the limited utilization for washing underwear only, as well as its insufficient efficiency in washing the same. There are also possibilities for damaging the material or for sharply reducing the efficiency of the washing process in case of non-compliance with the specified ranges of the acoustic vibrations and the impulse frequencies.

Another device of vibration type for washing textile materials is revealed in patent No2047676 - RU. The known device consists of a body, with an vibration element installed within the body. The space between the body and the vibration element is filled with a

sealing elastic compound. As a vibration element a piezo - ceramical plate with oval shape is used, the longitudinal axis of which being parallel to the wall of the body. The vibration element is connected to the power source, preferably the electric power supply network, the input frequency of the vibration element coinciding with the frequency of the electric power supply network, i.e. 50-60 Hz.

This known device is not efficiently enough, since it cannot provide quick washing of sufficient quality due to its limited range of vibrations, which depend on the frequency of the industrial electric power supply network.

Method and device for washing and cleaning – PCT/FR96/00783 – (WO96/37314) that relates to washing and cleaning of textile materials by emitting subsonic waves in liquid. The realization of the invention is by simultaneous emitting of subsonic waves, preferably in the frequency range of 15-25 kHz, and sound waves with frequency from 10 to 90 Hz. The subsonic wave reacts with the soils, and separates them from the textile surface while the sound waves removes the separated soils. The use of subsonic waves at the same time with sound waves improves the resonance of the water and helps the washing.

The device, used for realization of the described method, consists of body with devices for emitting acoustic waves inside it, which are elastic solid membranes in contact with the liquid. The device for emitting acoustic waves generates subsonic waves with one or more frequency from 15 to 25 kHz and sound waves with one or more frequency in the frequency range between 10 and 90 Hz.

Known are method and device for cleaning textile materials in water environment. The method consists of simultaneous influence of subsonic waves with frequency 6.5-8 kHz and sound waves with frequency 80 Hz for period of 30 to 50 minutes. For the realization of the said method a device for cleaning textile materials is used, which includes body, with device for generating acoustic waves and device for emitting acoustic waves placed inside it, where the generator of subsonic and sound waves is situated in a power supply unit and the device used for emitting acoustic waves is a piezo-ceramical element located in a bearer, situated asymmetrically on the shortest axis of a oval active element. It is known that there is a presence of calcium and magnesium hydrocarbonates, in the water used for washing that aggravates its quality as washing environment. After washing in such water the

hydrocarbonates remains included in the textile fibers and causes aggravation of their mechanical qualities and appearing of stains which reduces the efficiency of cleaning textile materials.

SUMMARY OF THE INVENTION

The aim of the invention is to provide a method and a device for cleaning textile materials in a water environment, which enable an efficient and fast cleaning, disinfecting and softening of soiled textile materials of natural and of synthetic nature at a guaranteed protection of the quality, the colour and the structure of the washed material.

The above stated objects of the invention are achieved by means of a method for washing textile materials which includes treating of the textile material with sound and supersonic waves into water environment and with the presence of washing detergent.

Method characterize with that the textile material are treated in water environment for 40-60 minutes under simultaneous influence of sound and ultrasound waves with frequency range of from 8.5 to 32kHZ and with presence of constant magnetic field with intensity 10-50Gs. Due to the action of subsonic waves, silver particles with size 10-100 nm are dispersed in the washing medium creating concentration of silver ions at about 1.10-7-2.10-8 g/l.

The Method according to the invention realized using device for treating textile materials including generator and activator, connected to the each other electrically. The activator consists of a body with transmitter of mechanical fluctuations, placed inside it. The transmitter of mechanical fluctuation consists of water resistant body with at least 4 magnets placed inside the body at equal distances from each other forming a circle with piezo-ceramical element inside magnets must be even number. The poles of the magnets are perpendicular to the plane of the piezo-ceramical element, and creates spherical constant magnetic field. The surface of the magnetic poles must be equal or smaller than the surface of the piezo-ceramical element. Preferably the piezo-ceramical element has cylindrical shape with size of the diameter and its height in 5:1 ratio. The walls of the transmitter are in mechanical contact with the piezo-ceramical element.

The piezo-ceramical element is connected to the generator through electric cable. Two elements made of porous material saturated with silver particles with size 10-100 nm and quantity 0,2-0,5 g are placed on both sides of the transmitter and in parallel to the plane of the piezo-ceramical element.

According to one embodiment of the invention the transmitter contains piezo-ceramical element shaped as cylinder, truncated cone or spherical element.

According to one embodiment of the invention the transmitter contains two piezo-ceramical elements placed in a distance to one another and the four magnets placed in non-circular shape at equal distance from each other.

According to another embodiment of the transmitter it contains one piezo-ceramical element and six magnets placed in non-circular form.

According to preferred embodiment of the device the generator is made as controllable generator with compulsory excitation.

The proposed method and device for cleaning textile materials provide an efficient cleaning and disinfecting and softening of the soiled clothes in water environment combined with washing detergents. The cleaning effect is achieved due to well-chosen frequency ranges within which the generator and the piezo-ceramical element operate providing effective distribution of the mechanical energy of the subsonic transmission on the surface of the textile material i.e. where the solids are located.

The device provides fast and effective cleaning disinfection and softening of the clothes of natural and synthetic textile material and guarantees protection of the quality, color and structure of the washed material.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiment of method and device for treating textile materials in water environment according to the invention is presented with reference to the accompanying drawings in which:

- Fig.1 presents a block diagram of the device according to the invention;
- Fig.2 is a plain view of the active element;
- Fig.3 is an electric diagram of the generator block;

DETAILED DESCRIPTION OF THE INVENTION

With reference to the accompanying drawings one embodiment of the method and the device for cleaning textile materials, according to the invention will now be described. The elements and materials specified therein are not to be considered as restricting the use of other known materials of similar characteristics and parameters.

The method for cleaning textile materials consists of following sequence of steps: a known type of washing detergent is added to a water, warmed up to a temperature of 45 C to 60 C while stirring until the washing detergent is fully dissolved.

The textile material to be washed, e.g. made of natural materials (shirts, blouses, underwear) is then placed into the container with the active element placed underneath the same in he washing water environment. The power supply is then connected to the electric power supply network with voltage 220V/110V and the generator block starts to emit vibrations within the range of the 8,5 to 32 kHz modulated by amplitude with frequency of the power supply network – 50 – 60 Hz. The impulses are transmitted trough electric cable to the piezo-ceramical element placed in the transmitter and transformed into mechanical vibrations which interact with the water solution and the clothes to be cleaned for 40-60 minutes. The method assumes that the treatment of textile materials take place in water environment during simultaneous influence of supersonic mechanical vibrations and constant magnetic field. The interaction between those two physical factors is related to he influence of the magneto hydrodinamic effect on the treated textile materials and helps destroying the hydrocarbonates which leads to the softening of the water and the treated clothes at the same time under the influence of the subsonic waves the water solution is saturated with silver particles with size 10-100 nm and creates concentrations of silver ions 1.10-7-2.10-8 g/l.. The ions in the silver have antibacterial effect. During the washing they permeate in the textile fiber and preserve their action for 20-30 days.

The device for cleaning textile materials in water environment consist of generator 1 connected electrically to the activator 2, implemented as symmetrical body (Figure 2), that consists of upper and lower decorative grid 3 and 13 and situated underneath them elements 4 and 12, made of porous material including in its volume silver particles with size 10-100 nm. The elements 4 and 12 are in acoustic contact with the body of the transmitter, made of upper and lower part 5 and 11 in which the fixed piezo-ceramical element 6 and the magnets 7,8,9,10 are placed.

Preferably the piezo-ceramical element can be shaped as a hollow cylinder and the ratio between the inner and the outer diameter can be in the range of 1:3 to 1:5. The ratio between the outer diameter and the height must not be less than 5:1. It is appropriate that the piezo-ceramical element is filled with lead titanit, and to provide along the diameter frequency of the free resonance of the piezo-ceramical element up to 80 kHz. It is appropriate to use magnets with cylindrical shape where the ratio between the diameter and height are in the range of 1:4 to 2:6, preferably 1:2,5. It is possible to use permanent magnets with nickel holding, molten rare earth metals with NdFeB composition and magnetic induction from 600-800Gs. or molten rare earth magnets with SmCo composition with the same magnetic induction.

According to embodiment of the device it is possible to use only one cylindrical shaped multypole magnet with even number of poles with ratio between the outer and inner diameter in ranger of 1:1,2 to 1:1,5.

The elements are filled with porous material and are made of ceramic mixture with connecting substances. The relative density of the ceramic element with porous structure can be in the range of 1,8 to 2,2 g/cm3 while the total surface of the capillary is in the range of 35 to 50 m2/g. The ceramic element is saturated with silver particles with size 10-100nm aue to restoring of silver compounds. In another embodiment of the invention active coal formed as tablets is used as a silver carrier with full surface of the capillary from 80 to 120 m2/g.

The generator is realized as controllable generator with independent excitation. The base of the generator 1 (Figure 3) is integrated circuit IS1 containing relaxation RC-generator, logical elements an driver for controlling the MOSFET transistor. The frequency of the generator is determined by the values of the elements R3, P1 and C5. At the exit HO and LO of the integrated circuit IS1, dephased at 1800 impulses are obtained that switch consecutively transistors T1 and T2 included in semi-bridge circuit. Due to recharging of the condenser C7 current flows through the winding W1 of the transformer T1 which induces current in winding W2. The inductivity of winding W2, дросел L1 and the capacity of the piezo-ceramical element forms oscillating circle, set to the frequency of the radial resonance of piezo-ceramical element.

The effective work of the transmitter determine that the frequency of the generator and the oscillating circuit always coincide with the mechanical resonance of the piezo-ceramical element. It is imperative to correct the frequency of the generator at all time due to dependency of the mechanical and electrical characteristics from the temperature. This is achieved with the help of feedback that includes elements R6, R7, C8, C9 and D2, which produce compensating voltage proportional to the difference between the generator frequency and the resonance frequency of the piezo-ceramical element. The said voltage is applied to the entry Ct of the integrated circuit IS1 and ensures the automatic setting of the generator.

The impulses are modulated by amplitude with frequency of the power supply network due to the small coefficient of filtration of the rectifier group, comprising of bridge rectifier DB1 and the condenser C3.

INDUSTRIAL APPLICABILITY

The device for cleaning textile materials is foreseen to be used in the following manner: 10 litters of washing solution is prepared in appropriate vessel by mixing water

warmed up to 50 to 600 with a washing (powder, liquid, etc.) detergent, the quantity of this solution being prepared in accordance with the instructions of the manufacturer. The solution is the stirred until the washing detergent is fully dissolved. The active element 4 is then placed on the bottom of the container, over which the textile materials, for example clothes of natural or synthetic material, shirts, blouses and underwear, to be cleaned are freely placed. The generator is then connected to the power supply network with voltage 220V and its frequency is synchronized to the frequency to the mechanical resonance of the transmitter. Upon connection the generator starts to emit signals, within a range of frequency at about from 8,5 to 32 kHz, modulated by amplitude with frequency of the power supply network – 50 - 60Hz. The impulses are applied trough electric cable to the piezo-ceramical element situated in the transmitter and then transformed into mechanical vibrations, which are transferred to the water solution and to the textile materials to be washed. Duration of the treatment is 40-60 minutes.

Operation of the device is based on a combined influence of subsonic and constant magnetic field over the liquid. During the distribution of subsonic within water environment mechanical vibrations occurs which creates alternate areas of lower and higher pressure. The alternation of the pressure of the environment transmits to the textile materials by the dipped into the washing solution transmitter, which creates favourable conditions for accelerating the physicochemical processes, that leads to dissolving and eliminating the contamination of the textile materials.

There is always presence of hydrocarbonates of calcium and magnesium In the water used for daily necessities , which makes it "hard" and worsens the quality of the water as a washing environment. After washing in "hard water", the hydrocarbonates of calcium and magnesium remains in the fibers of the textile materials and worsens their qualities.

The simultaneous influence of high-frequencies mechanical vibrations and constant magnetic field over the water environment creates the magnetichydrodynamical effect, which helps for the destroying of the hydrocarbonates of calcium and magnesium and leads to softening the water.

Under the influence of supersonic transmission from the elements, situated in the immediate contact with the transmitter, silver particles with 10-100nm size are exerted and pass into a ionic condition generating concentration of silver ions in a range of 1.10-7 -2.10 - 8 g/l. Silver ions have marked bactericidal influence. During the laundry they penetrate into the fibers of the textile materials, and their bactericidal action continues for 20-30 days.